Local Watershed Management Planning in Virginia

Virginia Watershed Advisory Committee

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Acknowledgement

The impetus for initiating this guide is the watershed commitment section in the latest Chesapeake Bay Agreement – Chesapeake 2000. However, the Virginia Watershed Advisory Committee, a consortium of Virginia agencies, regional organizations and local government representatives involved in watershed management and restoration, soon recognized that the voluntary principles of watershed management planning could benefit water quality and localities statewide.

In fact, early survey work done by the committee shows that many Virginia localities are involved in watershed planning in some form or fashion. This guide and other efforts by the committee are intended to provide guidance and consistency to watershed planning efforts.

The advisory committee developed the structure and themes for this planning tool. The University of Virginia Institute of Environmental Negotiation was hired to develop the guide. We hope the results will be helpful.

Virginia Watershed Advisory Committee

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Dear Reader,

Thank you for your interest in Virginia's environment, and your review of this guidebook, *Local Watershed Management Planning in Virginia*. It explains a useful tool the state is promoting to augment local natural resources stewardship. To enhance and protect the Commonwealth's land and water resources, it is essential that local communities become engaged in protecting local watersheds. Watershed management planning can generate new support for water quality by connecting local citizens to the rivers and streams in their communities.

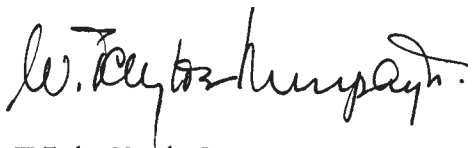
For more than a year, representatives from state agencies, local governments, and community watershed organizations have met to develop this guide and the methods by which the Commonwealth of Virginia will meet the commitments in the Chesapeake 2000 Agreement (C2K) dealing with watersheds, land use management, and local government responsibilities relating to water quality. The efforts to improve water quality in the Chesapeake Bay are generating similar interest statewide, and the guidance offered in this book is applicable throughout Virginia.

Local Watershed Management Planning in Virginia provides an approach to increase local government and citizen engagement in water quality and land use management. It does not suggest a new program area or requirement; rather, it provides a method to integrate and implement current programs to meet local, state, and federal needs. This guide complements Tributary Strategies, Total Maximum Daily Load (TMDL) implementation plans, and local comprehensive planning.

It is my hope that this guide will be used in conjunction with other Virginia programs to help localities, in partnership with citizens, to recognize their goals for local watersheds. As Virginians work to plan and implement water quality strategies, local watershed management efforts will prove to be an effective mechanism for making pollution reductions at the local level. This guide identifies sources of technical assistance available from the state and describes the key roles of many different stakeholders. As you work through the development process for your local watershed management plan, please do not hesitate to utilize these resources and make the most of local partnerships.

I appreciate the efforts of Virginia's counties, cities and towns, and its citizens to help the Commonwealth meet the water quality goals to which we are committed.

Sincerely,



W. Tayloe Murphy, Jr.
Secretary of Natural Resources

Section One: Introduction

A watershed management approach can help coordinate ongoing or proposed natural resource based planning efforts.

Watershed: The total land area within which all surface waters flow into a given river, lake, ocean or other body of water. Virginia has 494 local watersheds that encompass 50,239 miles of rivers and streams.

Watershed Management: An effort to coordinate and integrate the natural resource based programs, tools, resources, and needs of multiple stakeholder groups within a watershed to conserve, maintain, protect and restore the habitat and water quality of the watershed.

Watershed Management Plan: A detailed vision and strategy, usually at the small watershed level, to achieve watershed management. Many times initiated by local governments in conjunction with other local planning efforts. The planning effort identifies specific actions to restore habitat and water quality, identify lands for conservation and development, identify and reduce nonpoint sources of pollution and prioritize pollution reduction actions.

Local Watershed Planning

Environmental planning conducted by local governments, agencies, and communities requires prioritizing goals and addressing needs that incorporate a wide range of social, economic, and environmental factors. New considerations about water quality, stream management, habitat restoration, and the relationship between land use planning and healthy watersheds have become key components of planning efforts at the community and regional levels.

Over the past decade, the benefits of using watersheds as a natural delineator for these local, natural resource based planning efforts have been gaining attention. More localities are turning to watershed management planning either as a part of their existing comprehensive planning or to promote regional cooperation. On the state level, developing nutrient and sediment reduction tributary strategies is an example of planning by watershed.

Designed to give local government planners guidance and a framework for developing strategies that will lead to improved management of local watersheds, this guide was developed by a consortium of Virginia agencies, regional organizations and local government representatives involved in watershed management and restoration.

The development of effective watershed management plans can assist Virginia's localities in meeting new regulatory requirements, including the Total Maximum Daily Load (TMDL) and storm water provisions of the federal Clean Water Act. The development of these local plans will also help the Commonwealth meet its commitments under the Chesapeake 2000 Agreement

The consortium recommends a watershed management plan with eight basic components to effectively capture local needs and assist in meeting the state commitments previously mentioned. This guide provides a checklist and background narratives on each of the eight components. It also explores the relationship between local watershed management planning and larger state and federal water quality programs such as TMDLs and tributary strategies.

This guide was developed for local government staff and other planners familiar with natural resource planning initiatives. The consortium has also developed *A Watershed Management Planning Primer.* This primer is written for a lay audience providing more background on concepts covered in this guide and appendices providing a variety of resource materials.

Intended Audiences

The primary audiences for this guide are local governments, including engineering, public works, and planning departments, interested in devising a coordinated plan to manage and protect their local natural resources. Entities involved in regional planning, such as Soil and Water Conservation Districts and Planning District Commissions, can also use it to provide a framework for their watershed planning processes. Additional users may include elected bodies such as city councils and boards of supervisors, as well as appointed officials like planning commissioners or water planning boards. Community watershed and environmental groups, civic groups, and neighborhood associations can use the guide to plan projects or to suggest watershed protection strategies to elected officials and government agencies.

Watershed Management Planning Benefits

The protection and restoration of local watersheds provides a variety of benefits for Virginia's natural environment. A watershed protection strategy can protect and improve the quality and quantity of water for the survival of fish, wildlife, and people. Stable floodplains and buffer systems, with a diversity of native flora and fauna, are an important goal for any watershed because they reduce the likelihood of flood events and provide aesthetic benefits like natural beauty and community-wide recreation opportunities.

Every community in Virginia has a primary planning tool in place: the Comprehensive Plan. In addition, many communities have included water protection as a component of their Comprehensive Plans. However, localities' plans may not adequately address specific strategies for the implementation of water protection goals. A watershed plan provides an opportunity to develop these strategies, providing an effective ecological and physical framework for planning. The water quality of streams provides a direct measure of impacts from land uses in the watershed. Healthy streams with a diversity of aquatic life, stable stream banks, vibrant native vegetation, and healthy floodplain and buffer areas can indicate that a

watershed is well protected.

However, rivers and streams can become degraded quickly, as inadequate storm water management and resultant high flows, toxic waste spills, contaminated rainfall, removal of streamside vegetation, stream channelization, and other human impacts take a heavy toll. The impacts from natural events like hurricanes and extreme floods also may harm rivers and streams, but these events are far less frequent than the disturbances mentioned above. The potential interplay of these dynamic factors over time means that localities must develop and implement active watershed management plans to ensure that environmental quality and public health are protected.

In addition to protecting the environment, a watershed-based approach to land management also provides important benefits for the economy and for Virginia's communities. If watershed plans involve goals to not only protect, but also to improve watersheds, the plans can also spur ancillary benefits like enhanced real estate values for homes and businesses located near river greenway trails or restored recreational opportunities like fishing and canoeing. Effective watershed management can provide a new context within which to evaluate community goals and assess current and projected land use patterns.

Local Government Benefits

With all the natural resource planning responsibilities currently facing local governments, why would they consider taking on watershed management planning? Because in many cases using a watershed management approach can help coordinate ongoing or proposed planning efforts. Watershed management planning is not a panacea, but it can provide a framework to coordinate existing planning, whether it is done as a component of a localities comprehensive plan, or to coordinate multi-jurisdictional planning efforts. Many local governments already possess many of the component pieces of a watershed management plan and a plan make these components more accessible and useful. Here are just a few benefits of watershed management planning:

- *Provides a framework to identify resource issues and constraints that impact development and land use decisions.*
- *Helps localities prioritize resources such as money, time and staff*
- *Using natural rather than jurisdictional boundaries provides vehicle for regional cooperation*
- *Targets geographic areas for both land conservation and development*
- *Provides a holistic approach that views interdependent issues under one framework, leading to greater efficiency in the use of resources.*
- *Helps plan for community sustainability, balancing environmental protection, economic development and quality of life.*
- *Can provide a forum for community involvement and self-determination; provides for community and interest group input before there is a crisis.*

Lessons from localities involved in watershed management planning

Several local government planners who work for governments currently using watershed management planning were asked about benefits they had experienced:

- *Serve as a framework for meeting NPDES regulations and other storm water planning*
- *Address cumulative environmental impacts of development*
- *Rational way to integrate objectives ranging from protection of sensitive resources, providing green infrastructure to accommodate balanced development, to greater interest in and support of environmental programs.*

When asked about major selling points to other governments, the most common responses were:

- *Helps meet regulatory requirements*
- *Enhances environmental planning*
- *Improves relations with citizen groups*
- *Enhances support for environmental programs*
- *Cost efficiencies from more coordinated planning*

Section Two:

Taking stock of existing planning activities in your watershed - the Virginia Watershed Management Planning Guide Checklist

Taking stock of your watershed – both the landscape and existing planning initiatives — and determining plan components are key initial planning steps

A first step in any watershed planning effort is taking stock of the conditions in the watershed or local planning area. This chapter will help outline the key components needed in a plan, components that will help you take stock of the natural and man-made attributes in your watershed.

However, an element that is often overlooked when beginning a new watershed planning process is reviewing and categorizing local natural resource-based planning that has already taken place. Often times many components of a watershed management plan have already been completed as the result of previous local initiatives. Not all of these initiatives will be "watershed-based," many will be jurisdictionally based. Many localities are closer to an actual watershed plan than they might anticipate. Taking stock of previous efforts can be a critical and time saving first step. Use this checklist to determine the degree to which you already have in place the components and functions of a watershed management plan. This checklist is designed to:

1. Document the nature and extent of existing activities that are planned and implemented with a watershed or drainage basin as the planning unit; and
2. Identify activities that, while not planned and implemented on a watershed basis or within a watershed context, would be included as elements of a watershed management plan.

Key Components for an Effective Plan

In developing the actual watershed plan; it is important to understand the key components that help to create an effective plan. There are several key threshold components shared by all effective watershed plans. These components should be part of local watershed plans so that the plans meet Virginia's environmental protection goals and criteria for effective watershed protection plan strategies.

An effective watershed plan should:

- *Establish a vision for the watershed and goals that improve, enhance or protect water quality and habitat;*
- *Identify key stakeholders, stakeholder roles and responsibilities, and a clear participation process; involve stakeholders so that they become invested in the plan*
- *Assess and evaluate the current state of the watershed and identify critical concerns;*
- *Develop a framework of institutional and regulatory responsibility;*
- *Set goals based on results of data evaluation;*
- *Based on the plan's goals, identify clear and achievable strategies. Create an action plan providing responsible parties and timeframes for completion;*
- *Identify all resource needs including funding and technical support. Identify financial limitations; and*
- *Provide progress benchmarks as part of a process for using and applying the watershed plan and adapting it as needed over time.*

The inclusion of these eight key components in the watershed planning process will help to ensure that the plan's outcomes will result in a comprehensive approach to watershed management that meets community needs. Watershed plans can also incorporate additional community goals and related outcomes, such as protecting recreational opportunities like fishing and boating, providing river or lake access at appropriate locations, protecting current or future water supplies for drinking water, fish and wildlife and/or recreation, protecting cultural and historic resources, protecting threatened or endangered species, restoring stream habitats, or providing river greenway parks.

Virginia Watershed Management Planning Checklist

The checklist on the following pages provides you with the means of identifying areas throughout the planning process that may need more work. However, it is key to

Watershed planning for future land use

Effective watershed planning must also take future land use trends into account from the outset. Watersheds are dynamic systems and exist within a changing landscape. Unless the watershed lies within a stable land use pattern, such as within a national wilderness area, land use changes like new residential and commercial developments will have an impact on a watershed's hydrology, habitat, wildlife, and water quality. As a result, planning efforts should consider the potential impacts of future build out scenarios.

If every land parcel was developed to its maximum allowed density of land uses, for example, would the amount of impervious cover increase to the extent that watershed protection goals could not be met in the next decade? Based on these assessments of future trends, land use categories, Comprehensive Plan goals, and zoning regulations may need to be updated in order to meet future watershed goals or to sustain the watershed's current ecological health. Some areas, such as groundwater recharge areas or sensitive upstream wetlands, may need to be set aside for protection. Land areas of concern in a watershed may need to be rezoned so that they permit less-intensive land development, while other land areas can be rezoned to allow more-intensive land development, focusing new growth in designated areas.

keep in mind the ultimate purpose of your watershed management plan – to evaluate and identify problems and actions that impact water quality at the watershed scale.

This planning process should result in the implementation of specific restoration activities and changes in land use that will improve water quality and result in long term, visible, and quantifiable reductions in nonpoint source pollution.

Taking Stock: Planning Checklist

1 List the documents that comprise the watershed management plan(s):

2 Do the planning documents identify specific watersheds or hydrologic units as the geographic management unit?

If yes, go question 3 and then to Watershed Management Planning Components below.
If no, the planning process and documents must be revisited to focus on identified watersheds or hydorologic units.

3 List the watersheds or hydrologic units addressed in the watershed management planning documents listed above:

Compare the listed planning documents for each watershed or hydrologic unit with the following watershed management planning components to determine if the planning process meets the watershed management planning criteria and to identify opportunities for further effort.

Watershed Management Planning Components

1 Community involvement: Community involvement helps ensure that a plan has the necessary support to be implemented. Involvement can be *formal* (participants had decision-making roles) or *informal* (participants provided information or ideas).

Who was involved?	Formal	Informal
non-government stakeholder groups		
local/regional government agencies		
state/federal government agencies		
general public		
economic and business interests		
other (describe)		

Who is coordinating community involvement actions as part of the planning process (specific local government unit/office, local SWCD, others)?

NOTE: Representatives from each category must be present to meet the criteria for community involvement.

Which participants have endorsed the plan?	Yes-all	Yes-some	No	Don't know
local governments in watershed				
regional commission or planning district commission				
soil and water conservation district				
contributing non-government stakeholder groups				
economic and business interests				
other (describe)				

NOTE: Acceptance by the appropriate local government(s) is necessary to meet the criteria for community involvement. For more information on community involvement, see Section 3.

	Yes	No
Was a vision statement developed for the watershed?		
Was the vision statement developed by collaborative efforts of the stakeholders?	Yes	No

NOTE: A watershed vision statement must represent the shared values of the community and must be a product of a stakeholder process. For more information on vision statements, see Section 3 and Appendix B.

2 Environmental Inventory: An environmental inventory describes or characterizes the various features that comprise the watershed. The inventory may go beyond describing features and may include an assessment of their conditions.

Do the listed planning documents contain an environmental inventory?	Yes	No
If no, an inventory must be undertaken. See Section 4 for assistance.		

Do the listed planning documents include inventories with the following information?	Yes	WS-Based	Includes Assessment
Riparian System			
available chemical water quality monitoring data			
available biological monitoring data			
identification of major natural habitats			
rare, threatened or endangered species			
Physical Attributes			
Drainage areas			
Flood plains			
Wetlands			
Erosion potential			
Karst features			
Riparian conditions			
Stream sinuosity			
Buffer widths			
Vegetation type			
Tree canopy coverage			
Springs			
Water budget			
Existing land use/cover			
Land uses			
Existing uses			
Future uses			
Major forested areas			
Disturbed areas			
Flood mitigation areas			
Runoff potential			
Potential pollution sources			
Permitted point sources			
Identified nonpoint sources			
Protected areas			
Recreational uses/areas			
Significant sites			
Identification of missing or needed data			
Other			

NOTE: Bold items are readily available in Virginia and represent the minimum amount of data needed to develop a meaningful environmental inventory. For more information on conducting an environmental inventory, see Section 4.

3 Institutional and Regulatory Framework: This component outlines mandated and/or agreed upon roles and responsibilities within the watershed(s) and sets up the framework for implementation efforts.

Do the planning documents	Yes	No
identify agencies/organizations with mandated responsibilities?		
identify opportunities for coordination among agencies and organizations?		
outline existing environmental regulations and ordinances? (ie. CBPA, VPA, erosion and sediment control program, TMDLs, MS4 stormwater permits, comprehensive plan, overlay districts, etc.)		
identify areas where complementary efforts can be coordinated?		
identify gaps in institutional responsibilities?		
identify known financial resources? (capital improvement programs, grants, etc.)		
identify potential financial resources?		

NOTE: Identifying mandated and regulatory responsibilities is necessary to meet the minimum criteria for this component. For more information on related state and federal programs, see Section 5.

4 Data Evaluation and Goal Setting: This component establishes a link between the environmental inventory and desired goals for the watershed(s).

Do the planning documents	Yes	No
analyze data collected in the environmental inventory to develop goals?		
document clearly articulated goals based on local and watershed factors?		
have goals aimed at improving, enhancing, and protecting:		
water quality		
watershed habitats		
wetlands		
stream corridors		
riparian buffer areas		

NOTE: At a minimum the the identified plan goals should clearly reflect the watershed vision and address water quality and habitat. For more information on data evaluation and goal setting, see Section 6.

5 Implementation and Resource Needs: This component establishes resource limitations that will affect successful implementation of the plan(s).

Do the planning documents	Yes	No
contain strategies or identify tools for achieving goals?		
assign implementation responsibilities?		
identify sources of funding for specific goals?		
Assign projects to the local government(s) capital improvement program(s)?		

NOTE: Bold items are critical to assuring overall success of planning. For more information on setting implementation goals and evaluating resource needs, see Sections 7 and 8.

6 Progress Benchmarks: This component identifies the review and evaluation process critical to successfully implementing any planning effort.

Do the planning documents	Yes	No
establish a process for tracking accomplishments?		
establish a time-line for achieving milestones?		
establish a horizon for re-evaluation?		

What is the planning horizon? _____

NOTE: This component is critical to assuring overall success of the planning effort. For more information on establishing progress benchmarks, see Section 9.

If the comparison of planning documents to these criteria shows that the documents in question have not met the minimum standard for each component, the next step in watershed management planning is to complete missing or incomplete components.

If the comparison reveals that the planning documents collectively meet the minimum criteria, the planning documents represent a successful watershed managment planning effort and steps should be taken locally to formalize the effort. Opportunities to re-evaluate the watershed management planning effort to more fully meet the criteria can be pursued.

Section Three: A Watershed Vision and Community Involvement

The plan should articulate a clear vision for the watershed. The plan and vision will receive greater support if the community and local governments play active roles in their development.

A Vision for the Future

Without effective and sustained community involvement from the outset of a watershed planning process, a local watershed plan cannot be effectively implemented or sustained over time. A visioning process can be an effective way to involve the local community in the watershed planning process.

A vision is a description of future desired conditions. A visioning process can help the community determine what their watershed should look like in the years to come. A unified community vision for a watershed can help to ensure that community members and decision-makers are able to develop and support shared watershed goals. See the ***Watershed Management Planning Primer*** for additional information about the community visioning process.

The visioning process can produce a vision statement that encapsulates the shared understanding reached by community members. For example, a sample vision statement could state, "the Fluvial River shall flow freely and support an abundant and diverse ecology of native plants, fish and animals for the recreational enjoyment and economic health by present and future generations of citizens."

This vision statement describes a future where the river is not dammed, supports a diverse native ecology, and provides for public use and enjoyment. An effective vision statement can serve to express a community's shared interest in watershed planning and provide a rationale for the plan's development and implementation.

Watershed Plan Constituencies: Who Should Be Involved?

Potential Roles of Agencies and Organizations

The roles of different agencies, organizations, and constituencies in the planning process are also an important consideration in the development of a watershed management plan. An effective watershed planning process requires the involvement of a wide range of interested parties. A plan developed solely by staff in one government agency will likely fail because relevant agencies and organizations were never asked for their input, support, or assistance with implementation.

The initial step in developing a watershed plan is forming a core planning team. This team, consisting of representatives from different agencies and organizations, can be brought together to work on the plan and bring in experts and decision-makers on an as-needed basis. It is important to keep in mind that agencies and organizations will not need to play identical roles in the plan's development and implementation. The range of potential roles includes:

Oversight Organizations – parties that shepherd the plan through the development process. An organization or a team of organizations must be responsible for moving the plan forward, evaluating progress, and adapting the plan as needed to ensure that it reflects community goals and objectives. Examples of organizations that can serve in an oversight capacity include local departments of environmental protection, planning district commissions, and soil and water conservation districts.

Decision-makers – parties that evaluate the plan's development and content and provide formal political support for the process. Examples of decision-making organizations include boards of supervisors, planning commissions, city managers and county administrators, and state agencies with watershed management responsibilities.

Decision-shapers – community members and organizations that provide feedback on the plan's objectives, development, and content. Examples of decision-shapers include neighborhood associations, fishing, boating, and recreation clubs, community civic and religious groups, departments of tourism, business community representatives, land developers, the local chamber of commerce, local residents and, as appropriate, state and federal agencies.

Plan implementers – parties that will implement the watershed management plan. Examples of plan implementers include Soil and Water Conservation Districts, local land trusts, park administrators, local departments of engineering, public works, and planning, and local organizations including the farm bureau and chamber of commerce.

The roles described above illustrate how different shared agency and organization responsibilities can help lead to the successful creation of a watershed plan. Parties' actual roles and responsibilities will vary by locality.

A role for government?

Federal, state, and local government entities may be interested in the management of the watershed. If the watershed includes national park lands and has a stream undergoing a TMDL process, the involvement of the National Park Service and the Virginia Department of Environmental Quality would be encouraged. If the watershed falls within the jurisdiction of the Chesapeake Bay Preservation Act, the Chesapeake Bay Local Assistance Department should be contacted. A local Planning District Commission will cover all or part of the watershed and may be engaged in planning activities within the watershed. Several counties and cities may fall within the watershed's boundaries and their planning commissions, councils, and boards of supervisors can be invited to participate in the plan's development.

Key Constituencies in the Planning Process

Identification of the diverse range of agencies, organizations, and constituencies required to develop a successful watershed plan requires extensive research and community outreach. The identification of stakeholder groups should be far more extensive than simply distinguishing between government and non-government organizations.

Once project stakeholders have been identified, a stakeholder advisory committee comprised of key watershed constituencies can be formed to provide advice throughout the process to the core planning team. Each stakeholder advisory committee, made up of key watershed constituencies, can review plan drafts and provide detailed feedback to the core planning team. The committee can also help identify issues, prioritize concerns and assist with community outreach efforts.

Examples of important constituencies to invite to participate in the process include:

Agricultural community – farmers, agri-business and farm advocacy groups such as local farm bureau representation.

***Business*:** local small and large business owners, or a business representative like a member of the local chamber of commerce.

Government – local government planning staff, soil and water district staff, local extension service, and state or federal government staff.

Universities and schools – faculty from a local university may be able to provide expertise and resources, including printing or mapping capabilities. The university may also be a large landholder in the watershed. Schoolteachers may offer environmental education, water monitoring, and river restoration classes.

***Tourism community*:** local tourist bureau staff, local tourist attraction staff/ owners can be valuable resources for watershed planning efforts that address recreational opportunities and water-related historical resources like canal locks and dams.

Development community – members of the development community should be engaged particularly in watersheds that are experiencing rapid growth; developers may not wish to serve on the steering committee, but having at least one of them in the planning stages may encourage other developers to participate later on.

Environmental and conservation groups – local environmental groups, land trusts and "friends of" groups, especially those with an interest in rivers and streams; if there are many groups in the watershed, several representatives may need to be involved.

Civic organizations – although they may not historically have worked on watersheds, many civic groups, such as Lions Clubs or Ruritans, undertake a range of community projects, especially in rural areas. Garden Clubs and Native Plant Society chapters are also active in urban and rural areas. In urban areas, the Urban League and Boys and Girls Clubs may be valuable resources. Other service organizations, such as Conservation Corps or Americorps teams, may lend young adults to assist with watershed projects and planning efforts. Church groups may also be an important resource.

Individuals – individual community residents may have important perspectives to share as part of the watershed planning process. They may also represent other individuals through Neighborhood Associations or other civic or professional affiliations.

Community leaders – community leaders are those individuals with a formal or informal leadership role in the community. Community leaders can help with outreach and education efforts and help build community support for the watershed planning effort.

Before engaging with potential stakeholders, it is important to establish clear objectives for their involvement. Sample objectives for stakeholder engagement in watershed planning include:

- *Increase community awareness and understanding of watershed management needs and community benefits.*
- *Provide meaningful participation options for a diversity of stakeholders.*
- *Incorporate community ideas into the scope of the watershed plan.*
- *Achieve community buy-in and support for the final plan.*

To engage different stakeholders, a range of outreach approaches should be considered. Watershed planners should attend forums, club meetings and gatherings of key stakeholder groups to enlist their participation.

To engage different stakeholders, a range of outreach approaches should be considered. Watershed planners should attend forums, club meetings and gatherings of key stakeholder groups to enlist their participation. If there are residents in the community who speak different languages, materials and workshops can be provided in different languages. All formal and informal community gatherings, including barbecues and concerts as well as public meetings, can be considered as an opportunity for outreach.

Watershed plans should be tailored to address the needs, interests and conditions of each watershed and community. Below are examples of a phased stakeholder outreach process that can be adapted to meet communities' requirements:

Phase 1: ***Provide a watershed briefing and scoping forum*** for key stakeholder groups to learn about the watershed's condition and to discuss and prioritize key watershed issues that will need to be addressed by the plan. Incorporate these issues into formulation of a draft watershed plan.

Phase 2: ***Hold a community watershed forum*** to present draft approaches to key stakeholder groups. Revise plan to reflect stakeholder input and distribute paper and online copies of the draft plan

for community review.

Phase 3: ***Offer a draft plan review workshop*** to obtain additional community input on the proposed plan. Incorporate these changes and develop the final plan.

Phase 4: ***Hold a final plan review workshop*** to present the final plan to the stakeholder advisory committee and the community. Identify final suggested changes and submit final plan and associated comments to local decision-makers for review/adoption.

In order to be able to provide accurate and comprehensive watershed information for these meetings and the planning process, relevant watershed data will include:

- *existing baseline stream and riparian conditions*
- *existing regulations to protect or restore the watershed's streams*
- *the existing zoning and current land uses and impacts*
- *an analysis depicting future watershed land uses with full implementation of current zoning and predicted impacts to stream flows or water quality*

Section Four: Environmental Inventory

A comprehensive watershed management plan should be based on an inventory of existing conditions, resources and impairments as well as the relative condition of each.

Understanding and Evaluating Current Watershed Conditions

Assessment of current watershed conditions is an important initial stage of watershed plan development. However, this assessment does not necessarily require extensive new research. State and local agencies including the departments of Conservation and Recreation, Environmental Quality, and Game and Inland Fisheries may have existing stream, river, and watershed data that can be used to develop the initial assessment. In addition to evaluating water quality in the watershed, the assessment should also review the potential environmental impacts of current and future land uses within the watershed's drainage area.

The development of the watershed plan will also result in the identification of additional data needs. Some data needs can be met while the plan is being developed or as part of the plan's review and evaluation strategy. For example, if the plan identifies the restoration of 200-foot-wide riparian buffers as an objective, then a watershed assessment will need to determine the size of existing buffers and identify areas that do not meet the preferred buffer width. The watershed plan can then target those areas for restoration.

The extent of the research devoted to each element will depend on the resources available to the government doing the plan. To develop an effective plan, you are encouraged to devote some effort to each of the inventory categories listed below. Even a cursory examination of an element is better than deciding not to address it because a comprehensive review is not feasible.

When the lack of resources for paid professionals is a factor, consider the use of volunteers to conduct research and site visits. This is another way to engage citizens, particularly members of existing groups, in the development of natural resources planning.

Once created, the resource inventory can help determine watershed plan priorities. For example, the inventory can be used to identify areas that urgently require restoration or protection, as well as the areas that could be cost-effectively restored or protected. Based on the resource inventory, the watershed planning process should be able to incorporate the costs and potential benefits of different watershed protection strategies from the outset.

Below is a minimal list of environmental factors to be considered by a watershed management plan:

Physical features of the watershed

An understanding of the key physical attributes in a watershed is critical to effective planning. Elements to review include:

- *Drainage Areas*: land areas that drains directly or via tributaries into a particular river or body of water.
- *Topography*: particularly karst areas.
- *Wildlife:* watershed's animal species, including rare, threatened or endangered species.
- *Riparian Conditions:* streams' buffer widths, vegetation types, floodplain uses and condition, and tree canopy coverage.
- *Channel Stability:* channel and floodplain stability, including delineation of floodplains and flood-prone areas, the degree of sinuosity, and channel type.
- *Erosion Potential:* locations and percentages of steep slopes, especially areas with highly erodible soils, which may contribute to excessive siltation.
- *Water Budget:* characterization of water flows and storage throughout the hydrologic cycle. Entails an assessment of the amount of water is stored in various places, e.g., in aquifers and surface flows, and the amount of water needed to recharge aquifers. Development of a water budget can enhance understanding of the relationship between community water needs and the status of area surface and ground water resources.

Existing and future land use/cover

Complementing a review of physical attributes is the need for an assessment of current land uses, future land uses and existing laws and ordinances impacting both. Specific areas to review include:

- *Land Uses:* watershed land uses and zoning, including current land uses and their potential environmental impacts.
- *Runoff Potential:* percentage of impervious cover, measured by paved area and compacted soils in high-use areas, which affects rates and volumes of runoff and water quality.
- *Protected Areas:* percentage of land under permanent protection, like conservation easements or National Park lands.
- *Disturbed Areas:* land areas in need of remediation, such as abandoned mine lands, brownfields, etc.
- *Flood Damage Mitigation:* percentage of undeveloped land within the river's 100-year floodplain available to mitigate flooding impacts, compared with the percentage of developed land at risk during flood events.
- *Significant Sites:* historically or culturally significant sites, such as canal locks, dams, and Native American encampments.
- *Recreational Uses:* activities like fishing, hiking, and boating, as well as existing and projected access points for the activities.

Physical assessment of streams

The morphology of a river channel – its shape, its sinuosity, and the degree of stream entrenchment (carving of an over-deep channel and steep banks) – can all be measured to provide an indication of riverbank stability. The stability of a river's banks will affect rates of erosion, flooding, and habitat quality, which in turn can directly affect the health of the river. Habitat

restoration approaches can be used to realign river channels that have been altered by watershed development and high storm water flows, or by prior efforts to straighten the river's channel. However, these efforts to work in-stream should not be undertaken without a complete understanding of a stream's morphology and flow or without adequate engineering studies. The report *Applied River Morphology* is an excellent reference tool for understanding and evaluating river morphology.

Wetlands

Within the river's floodplain, surrounding riparian wetlands may help filter storm water runoff and provide critical nursery grounds for amphibian species, such as salamanders and newts.

Riparian buffers

Effective watershed management requires not only monitoring of a river's aquatic life, water quality, habitat, and morphology, but consideration of the areas adjacent to the river as well. A riparian corridor includes:

- *the river*
- *the river's banks and surrounding floodplain*
- *associated vegetation*

Major forested areas

An assessment of major forested areas is a useful component of land use/cover data.

Floodplains

Floods are the most commonly occurring natural disaster. Building in floodplains can cost local governments in terms of rescue and relief costs, emergency preparedness and a reduced tax base from blight in flood stricken areas. Properly maintained, floodplains are resources that provide natural flood and erosion control, protect water quality by filtering runoff and promote groundwater recharge.

Sensitive soils

Becoming familiar with soil types in your watershed will assist in determining potential erosion rates, stormwater issues and more. Data from the statewide soil survey are available for many counties. For soil survey information contact your local soil and water conservation district.

Major natural habitats

In addition to assessing water quality and aquatic life, river habitat should also be considered as a critically important component of river health. A river may meet water quality standards, but lack the requisite habitat needed to support certain fish species, such as trout that require deep pools, as well as runs, riffles, and overhanging roots and vegetation to provide cover from predators. In addition, high storm water flows may be scouring the streambed and banks, preventing the development of aquatic insect populations or fish spawning beds.

Water quality monitoring efforts (chemical and biological)

The status of a river's aquatic life serves as an important measure of a river's health and the effectiveness of ongoing watershed management efforts. For example, the amount, type, and distribution of fish in different parts of the river can provide indications of localized and general water quality concerns. Fish tissue analysis can also determine if there are sources of toxic pollutants in the river.

The health of a river's aquatic life is determined by the river's water chemistry and water quality. For example, acidity levels may affect the types of algae present in the river, which can in turn affect the types of aquatic insects and fish that can thrive. Low dissolved oxygen levels and higher water temperatures can provide breeding grounds for water-borne diseases. As a result, comprehensive water monitoring programs need to assess a river's chemical, biological, and physical health to enable the design of effective remediation or protection strategies.

The *Index of Biological Integrity* is one measure frequently used to evaluate the diversity of aquatic life in a river. Macroinvertebrates (aquatic insects and their larvae) and crustaceans are particularly helpful indicators of water quality, as many, such as the winter stonefly, are highly sensitive to pollutants. Accordingly, their relative abundance or absence in a body of water can serve as an indicator of river health. Biological monitoring of aquatic organisms can reveal water quality concerns that chemical monitoring approaches may not be able to identify. Citizen monitoring groups around the state currently do biological water quality monitoring.

Sources of pollution

A review of land uses and soil data will give a good understanding of nonpoint source pollution potential in your watershed. An inventory of point sources (wastewater treatment plants, industrial facilities, etc.) should also be undertaken.

Data Collection

Collecting all of the environmental and land use data needed to develop a comprehensive watershed management plan may appear to be a daunting task. However, existing local resources can provide a wide range of relevant data and expertise. Agency staff, for example, may have years of experience with local environmental and land use planning issues.

Staff in the public works department can supply data about streams that flood frequently, road culverts unable to handle two-year storm events, and areas suffering from extreme erosion. Staff from engineering and/or water treatment plants

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can provide information about streams and reservoirs suffering from high rates of nutrient over-enrichment. The public health department may maintain data on streams that have a significant incidence of fish kills. The local parks department may be able to provide water quality data, while the regional forestry department may be able to provide data about streams that require forested riparian buffer areas. These professionals may have access to data, including their own experiences, which are not available from any central database.

Similarly, there are many organizations and individuals in the watershed that can contribute data and technical expertise, including staff from local nature centers, fishing and canoe clubs, volunteer water monitoring groups, and school environmental clubs. The core watershed planning team should also serve as a valuable information source. The table below gives a brief view several state, federal and local information sources.

Data Sources: Commonwealth of Virginia

Type of Data	CBLAD	DCR	DEQ	DGIF	DMME	DOF	DOH	VDACS	VDOT	VMRC
Riparian System										
water chemistry			X		X	X	X			X
biological monitoring			X	X	X					X
habitat			X	X		X				X
rare, endangered or threatened species		X		X						X
water flow			X							
Physical Attributes										
wetlands										X
channel and navigation data									X	X
soils					X					
floodplain mapping		X								
riparian buffers	X	X				X				
topography		X			X					
shoreline erosion rates		X								
stream morphology data				X	X	X			X	
Existing Use and Land Cover										
conservation easements		X								
drainage and utility easements									X	
land ownership									X	
existing and historical land uses				X	X	X			X	X
zoning and subdivision regulations	X									
permitted point source discharges			X		X		X			
identified NPS pollutant sources		X	X		X		X	X		X
future land use									X	X
highway right-of-ways									X	
recreational and historical sites		X		X		X				
forest cover				X		X				

Data Sources: Federal, Regional and Local Agencies and Organizations

	Federal Agencies					Regional and Local Organizations				
Type of Data	**EPA**	**USDA-NRCS**	**USDA-FSA**	**USFWS**	**USGS**	**PDCs**	**SWCDs**	**CWOs**	**LOCAL GOV'T**	**Colleges and Universities**
Riparian System										
water chemistry	X				X		X	X	X	X
biological monitoring	X				X		X	X	X	X
habitat		X		X						X
rare, endangered or threatened species				X					X	X
water flow					X					X
Physical Attributes										
wetlands		X		X	X	X	X		X	
channel and navigation data										
soils		X			X	X	X		X	
floodplain mapping						X			X	
riparian buffers		X	X	X		X	X		X	
topography					X	X			X	X
shoreline erosion rates						X	X		X	
stream morphology data				X	X	X	X	X	X	X
Existing Use and Land Cover										
conservation easements			X			X	X		X	
drainage and utility easements						X			X	
land ownership						X			X	
existing and historical land uses		X	X			X	X		X	
zoning and subdivision regulations									X	
permitted point source discharges	X					X			X	
identified NPS pollutant sources	X	X		X	X	X	X		X	X
future land use						X			X	
highway right-of ways						X			X	
recreational and historical sites				X		X	X		X	
forest cover						X	X		X	X

Section Five: Framework of Institutional and Regulatory Responsibility

The plan should outline the agencies and organizations that have mandated or agreed upon responsibilities within the watershed and should identify known planning resources and opportunities for coordinating efforts.

Integrating Virginia Planning Initiatives

There are several planning initiatives in Virginia that either utilize or affect locally based planning efforts. Programs such as the Virginia Pollutant Discharge Elimination System Permits (VPDES) and Section 303(d) impaired waters and associated TMDL planning processes are examples of programs that can have an impact local watershed planning activities. Local watershed management planning is an approach that can bring together, or make sense of, these various programs at the local level while assuring that local input is integral to the planning processes. Seen in this light, local watershed management planning is not just another planning initiative thrust on local governments. In fact, local watershed management planning is a voluntary tool, not a mandate, which can assist localities in meeting state, regional, and federal program goals and statutory requirements. This section describes five programs that can be enhanced through local watershed planning efforts.

The following section discusses the relationships among several of Virginia's natural resource based planning initiatives including, TMDLs, tributary strategies, Stormwater Phase 2 and local comprehensive planning. Appendix A contains two charts that provide an overview of the programs and their relationships. Appendix B contains a description of each program in more detail as well as contact information.

The programs and plans described in this section represent a partial list of the processes that local watershed planning efforts need to keep in mind. At a minimum, conflicts with other management plans should be avoided. At best, watershed planning efforts should work in coordination with other processes to develop shared solutions that meet the needs of multiple constituencies, as well as restoring and protecting natural resources.

Total Maximum Daily Loads (TMDLs)

The 1972 Clean Water Act requires states to establish Total Maximum Daily Loads (TMDLs) for bodies of water designated as impaired based on water quality monitoring. Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (WQMIRA) requires the development and implementation of "a plan to achieve fully supporting status for impaired waters. The Virginia TMDL program is also governed by a federal court order Consent Decree that lays out a schedule for TMDL development through 2010. After 2010, TMDL development will be scheduled in accordance with applicable federal and state guidelines, typically within 12 years of the date the water was identified as impaired. DEQ is the lead agency for the program.

The TMDL for a water body represents the maximum amount of pollutant(s) the water body can receive and still meet water quality standards. Once monitoring data show a water quality problem (chemical and/or biological) in a body of water and the water is listed as impaired, Virginia must establish a TMDL for all pollutants causing impairment. This includes a watershed-wide assessment of pollutant sources and a determination of the pollutant reductions necessary to support the water body's beneficial uses, such as swimming, fishing, or aquatic life. Also included is a thorough public information and outreach effort to include all stakeholders in the assessment and development process. Once the TMDL is complete, a TMDL implementation plan (TMDLIP) is developed to set forth the specific actions and timetable needed to accomplish the TMDL.

Integration with local watershed management planning: By definition, TMDLs and TMDLIPs only address the pollutant(s) identified as causing the water quality impairment(s). While TMDLs and TMDLIPs focus on the entire drainage area, or watershed, contributing to the impaired segment, the plans will not address watershed activities or situations that are not related to the TMDL-specific water quality problem. Therefore habitat destruction may not be addressed as part of a TMDL for bacterial impairment. Similarly, a stream may currently meet state water quality standards despite having a diminishing, or downward trend, in quality based on available monitoring data. Water bodies may be vulnerable to decline as a result of rapid land use changes occurring in the associated watershed. Anecdotal data from residents within the community may support this conclusion. The TMDL development process is an excellent starting point for broader local watershed management planning efforts. By starting with an inventory of impaired streams or an existing TMDL, a local government can build on the existing stakeholder involvement and take a broader approach to water quality and habitat in a watershed that has become, by virtue of the TMDL process, an important local issue.

Virginia Tributary Strategy Program

The Virginia Tributary Strategy Program (VTSP) is a multi-agency effort to develop and implement large-scale water quality management plans that restore living resources in the Chesapeake Bay by reducing and eliminating nutrient and sediment pollution. Tributary strategies set nutrient reduction goals and develop implementation strategies at the major river basin level (i.e. Shenandoah, Potomac, Rappahannock, etc.). Virginia's tributary strategy program is the direct result of the Commonwealth's commitment as a Chesapeake Bay Program partner.

In the same way that TMDLs are developed for impaired stream segments and address specific pollutants, tributary strategies are based on pollutant load

reductions and address specific pollutants (nitrogen, phosphorus and sediment) for the entire Chesapeake Bay. Tributary strategies have been described as proactive TMDLs to address nutrients and sediment in the Bay since pollutant loads are assessed from all land uses and then reductions are allocated for each pollutant and for each major tributary. In the late 1990s Virginia set nutrient reduction strategies for each of the Bay's major tributary rivers and smaller creeks on the Bay's Eastern Shore based on pollutant load allocations provided by the Chesapeake Bay Program water quality model. As a result of the revised Chesapeake Bay Agreement, Chesapeake 2000, new nutrient and sediment goals and strategies must be developed in 2003 and 2004 for the Shenandoah, Potomac, Rappahannock, York, James and Eastern Shore watersheds.

Integration with local watershed management planning: Because implementation of each tributary strategy will be determined at the local level, local watershed management plans are a logical building block for the larger tributary strategy. Local plans can deal with water quality impairments of all types including those caused by nutrients and sediment and are an appropriate tool to coordinate both TMDL and tributary strategy implementation plans. Local planning that incorporates these efforts will involve land use decisions, stormwater management, erosion and sediment control and other issues that localities otherwise address.

Stormwater Management and the MS4 Permits

In Virginia, approximately 60 communities are affected by the Clean Water Act Small Municipal Separate Storm Sewer System (MS4) Program regulation and another five communities are being evaluated for inclusion. Small MS4 communities must develop, implement and enforce a local storm water program that addresses six minimum control measures including: public education and outreach; public participation/involvement; illicit discharge detection and elimination; construction site runoff control; post-construction runoff control; and pollution prevention/good housekeeping. DEQ has published a general permit to cover affected communities that sets a five-year timeframe for accomplishing local programs. EPA has developed a menu of best management practices (BMPs) to guide communities and states in the development of these local programs. Some communities will already have in place the necessary programs to meet the requirements and others will need to start from the beginning. Regional planning efforts are encouraged but not required.

Integration with local watershed management planning: The stated purpose of the MS4 program is to reduce the discharge of pollutants from stormwater to protect water quality. For some communities development of a local MS4 program will require mapping and evaluating the storm sewer system including the contributing watersheds and sub watersheds. Local watershed management planning can provide the wider context for evaluating the storm sewer system and addressing the six minimum control measures. A local watershed management planning approach will enable a local government to be more efficient in the use of community resources to engage stakeholders and address multiple issues that may be affecting the stormwater program.

Local Comprehensive Plans

Every locality in Virginia is required to develop a comprehensive plan that will guide the coordinated and harmonious development of land within the jurisdiction. Comprehensive plans generally include the guiding principals a local government employs to accomplish development as well as the specific regulations, such as the zoning maps and subdivision ordinances, which control the development process. Many localities also use the capitol improvement program as the mechanism to fund specific measures deemed important to the community through inclusion in the comprehensive plan. In developing and updating the comprehensive plan and its components, local governments generally evaluate land management concerns such as flood plains, wetlands, soil types, availability of ground water and the need to protect critical resources. As the tool that drives the type and intensity of uses permitted in different locations, zoning ordinances should be reviewed from a watershed-based perspective to assure that the regulations adequately address watershed protection goals, in accordance with the comprehensive plan. Local governments in Tidewater Virginia must address additional requirements aimed at restoring and protecting water quality in the Chesapeake Bay through the Chesapeake Bay Preservation Act. These localities must consider specific measures aimed at protecting state waters since it is well understood that the manner in which land is used has an impact on water quality and habitat.

Integration with local watershed management planning: The detailed environmental inventory included in a watershed management plan can provide an increased level of data and context to the guidance provided by the comprehensive plan. A thorough watershed-based inventory of the constraints to development and an evaluation of critical natural resources will add rigor to the comprehensive planning process, improve decision-making, and helping to establish policies that will drive needed zoning amendments. Including watershed management planning in the comprehensive plan will better connect and integrate natural resource goals with other plan goals like a high quality of life, safe drinking water, efficient and safe roadways, or abundant recreation opportunities, thus avoiding potentially costly mistakes and secondary impacts of land use decisions on water and habitat quality. Finally, using watershed management planning as a basis for the comprehensive plan sets the stage for the recognition that the locality shares watersheds and natural resource related issues with adjoining jurisdictions.

Chesapeake 2000

Chesapeake 2000, the most recent amendment to the Chesapeake Bay Agreement, contains a series of commitments to support local watershed planning efforts. Commitment 2.2, for example, stipulates that, by 2010:

- *state signatories will work with local governments, community groups, and watershed organizations to develop*

and implement locally supported watershed management plans in two-thirds of the Bay's watershed; and

- *local watershed management plans will address the protection, conservation, and restoration of stream corridors, riparian buffers, and wetlands for the purpose of improving habitat and water quality.*

Integration with local watershed management planning: Local watershed management planning is the appropriate mechanism to include stream corridor restoration and other measures to improve riparian buffers and habitat into other ongoing planning efforts at the local level. Furthermore, using a locally based watershed management approach to address such initiatives as tributary strategies will bring enhanced stakeholder and community involvement and buy-in to those efforts. Finally local watershed management planning is the most effective way for communities to consider how to it will meet the goals outlined in the Chesapeake 2000 Agreement. The nature of watershed based planning will help localities pursue opportunities to integrate their watershed plan goals and objectives with the regional watershed goals and objectives outlined in the Agreement.

Other Related Initiatives

Agency Natural Resource Plans

Relevant local and regional planning efforts focusing on regional parks, river trails, heritage tourism, recreation, and other natural resource opportunities could be linked with watershed planning efforts, improving the effectiveness of all planning efforts and mitigating potential conflicts. Processes of potential interest could include efforts managed by local, state and federal parks, planning district commissions, agricultural programs, extension services, or non-profit land management groups like land trusts. Effective coordination between watershed planning efforts and other community planning processes means that a comprehensive watershed plan can be developed, linking riparian restoration with enhanced eco-tourism opportunities, and meeting the needs of different community constituencies.

Transportation Plans

Proposed transportation projects can have profound impacts on nearby rivers and streams, as roads can increase runoff rates and help determine the location of future land uses and development. Virginia's Planning District Commissions or Department of Transportation can provide information about plans for new roads and improvements to existing roads throughout the Commonwealth.

Other Natural Resource Management Programs

There are many natural resource management and water quality programs in Virginia that support and enhance local watershed management planning. A number of programs provide assistance to the planning process, some programs provide assistance to plan implementation activities and a number of programs provide assistance for both. Appendix B contains descriptions and contact information.

Section Six: Data Evaluation and Goal Setting

Realistic natural resource goals should be set based on reliable data evaluation

Evaluating Watershed Challenges and Opportunities

With an inventory of the watershed's physical characteristics in hand, along with an understanding of local, state and federal program responsibilities in the area, it is time to evaluate this data with an eye toward setting specific goals that help reach the plan's stated vision.

Much like the data collection process, the evaluation should make use of a range of staff and volunteer resources available. This evaluation should seek to identify natural resource conditions in the watershed. An objective assessment of the human, monetary and programmatic resources available to improve conditions is also needed. To move toward an evaluation that will provide the basis for goal setting, data and staff expertise should be used to answer the following types of questions:

- *Which streams show the most signs of stress?*
- *Which streams show the least signs of stress?*
- *What are the watershed's risk factors and which bodies of water are most at risk?*
- *Which bodies of water have unique resources or habitats that should be protected?*
- *Which bodies of water are most likely to benefit from new management actions?*
- *Are wetlands in the watershed threatened by current development patterns?*
- *Which streams have adequate riparian buffers?*

Other questions may become apparent as you evaluate the available data.

Watershed Plan Design

An effective watershed plan should include clear goals for the watershed and measurable objectives designed to achieve those goals. In turn, the objectives can be broken down into a series of specific strategies, like a project to replant a specific stretch of riverbank or a project to monitor outflow from a point source.

Setting Goals

The detail and complexity of the watershed plan will depend on several factors, including the extent and characteristics of the challenges facing the watershed, available resources, the scale of inter-jurisdictional coordination, and the size and number of watersheds addressed by the plan. Goals for an effective watershed plan should address desired outcomes. For example, if the community identifies the protection of drinking water supplies as a primary need, streams that could serve as future water supplies could be targeted for protection. Specific goals that watershed plans could address include: meeting regulatory standards, protecting historic or ecological resources, addressing flood risks and property damage, promoting tourism and recreation, or integrating local ordinances to ensure the comprehensiveness of local watershed planning efforts.

Evaluating land use futures

In addition to assessing a watershed's environmental health, the watershed planning process also needs to take into account future land use patterns that may affect the watershed. Future land use changes or planned developments that may significantly modify land use, storm water management, or the stream/corridor system should be evaluated and mapped. When evaluating future land use impacts for a watershed, the assessment should consider:

- The percentage of the watershed's area zoned for future development and the type of development (e.g., parks or shopping malls) allowed under that zoning.
- The potential increase in impervious surfaces created by future development, including roads, parking lots and rooftops.
- Future demands on the water supply, such as new power plants or planned drinking water impoundments.
- Estimated increases or decreases in population and employment levels, which may have an impact on storm water flows and impervious surface

Sample Project Goals

- To protect and restore ecological health of the watershed.
- To enhance economic value.
- To provide recreational opportunities.
- To protect current or future water supplies.

Section Seven: Objectives and Implementation Strategies

To meet the plan's goals, clearly defined objectives and strategies providing responsibility and timeframes should be established

Setting Objectives

Once goals for the watershed plan have been identified, objectives that can help ensure that the goals are achieved need to be identified. For example, how will water quality goals be attained – through restoration, enforcement, and/or new zoning approaches? If a state statutory requirement like a TMDL is the primary reason that a locality is developing a watershed plan, the plan can still easily address additional watershed management concerns. A series of complementary objectives, like the identification and restoration of riparian wetlands and buffer areas, could be added to a TMDL management plan. These objectives also target the reduction of pollutant levels, serving to clean the water and reduce storm water flows, as well as providing restored wildlife habitat.

Sample Watershed Protection Objectives

- *Critical Habitats:* Define and identify sensitive ecological zones needed to maintain the ecological integrity of the watershed, e.g., sensitive wetlands, headwaters, wildlife corridors, assemblages of native plants and trees, stream buffers, and critical slopes subject to erosion.
- *In-Stream Habitat:* Protect and restore in-stream habitats, including stream banks, in-stream substrate, aquatic plants, riparian vegetation, and stream cover.
- *Stream Form and Function:* Preserve or restore the natural stream morphology consistent with local conditions to ensure that stable stream banks and habitat are preserved.
- *Riparian Habitats:* Protect and restore stream buffers.
- *Water Quality:* Set standards for allowed uses or discharges that will maintain or improve existing water quality.
- *Stream Flows:* Ensure adequate stream flow for animals, fish, and recreational uses that will prevent extreme storm water flows by keeping impervious cover to less than 15-25 percent of total land surface area and providing additional infiltration areas.
- *Access:* Identify, protect, and improve existing access points and provide new access points, where appropriate, for people or animals.
- *Floodplain:* Restrict or prevent development within the 100-year floodplain and protect floodplain habitats.
- *Wetlands:* Protect and restore riparian and non-tidal wetlands to ensure that water filtering, water storage and habitat functions are preserved.

Goal 1: Improve the water quality of Muddy Creek to provide for restoration of a healthy shad fishery.
Objective 1: Restore riparian and in-stream habitats.
Implementation Strategies:
1) Restore 120 linear yards of hardwood riparian buffer, 35' wide along the east side of Muddy Creek downstream from its confluence with Clear Run.
- Responsible Party: SWCD with Earth Conservation Corp volunteers
- Funding: DCR Watershed Grant and in-kind services of CH2Mhill
- Time: Fall 2004

2) Obtain agreement under the CREP program for 25 acres of agricultural land for reforestation, hardened cattle access, and fencing at the McDonald Farm along Muddy Run.
- Responsible Party: NRCS with SWCD
- Funding: CREP/Federal Match
- Time: Summer 2004

3) Conduct a survey on main stem of Muddy Branch. Recruit volunteers from the Blue Ridge Voyageurs to canoe entire length of main stem, noting on tax maps the exact locations where erosion is occuring along Muddy Branch. Link landowners with CREP and VA BMP cost share programs.
- Responsible Party: SWCD with volunteers
- Funding: SWCD
- Time: Winter-Spring 2004

4) Inventory and prioritize outfalls and impacts along upper tributaries of Muddy Creek for BMP retrofit and remediation.
- Responsible Party: County Department of Public Works
- Funding: Stormwater fees
- Time: Spring 2005

5) Meet with all 17 land owners in the Muddy Creek headwaters tributaries of Briny Branch and Upper South Fork to form a "neighborhood river watch". Identify and implement action items.
- Responsible Party: Watershed Association
- Funding: Volunteer time, with local general fund support
- Time: Fall 2004

Next step: Developing Strategies

Strategies are those specific actions that need to be taken in order to meet your objectives. A good strategy is ambitious but also realistic given the resources currently available and the outlook for resources in the future. These strategies should identify those responsible for their implementation and provide at least a tentative completion date. Often strategies build upon each other with some providing the critical path for the implementation of others.

Section Eight: Resource Needs

Identify resource limitations that will affect successful completion of implementation strategies. Funding and technical support needs should be clearly outlined.

Effectively leverage existing resources and mobilize new resources

An effective watershed plan should identify existing resources that can provide technical and financial assistance and work in tandem with existing programs. For example, the watershed plan need not include a stand-alone roadway plan, but should provide guidelines for existing road planning processes that can help engineers and government officials understand how road design can mitigate potential watershed impacts. Similarly, if the watershed plan calls for the protection of riparian areas, the plan can incorporate partnerships with existing local and state conservation easement programs rather than proposing the creation of a new program.

A watershed plan can also mobilize new community resources to support local watershed management. For example, Nelson County's watershed plan for the Rockfish River led to the formation of a new citizens' advocacy group that has begun water monitoring and re-establishing forested buffer areas.

Planning for Ongoing Funding and Management

All too often, plan failure is linked to a lack of adequate funding. To avoid this situation, each of the plan's objectives should identify a funding mechanism as part of the plan. Staff time will also be required to oversee, review, and adapt the plan as needed. Monitoring and evaluation of the plan may require additional resources from local engineering departments or necessitate hiring consultants to conduct the monitoring.

If sufficient staff and resources required for the plan's monitoring and evaluation are not available, this problem can be addressed in several ways. For example, a volunteer monitoring program can be implemented to collect data on stream quality and habitat, morphology, and buffer conditions. A local university planning and mapping class could develop a Geographic Information System map for the watershed. A local developer or contractor provide grading and tree planting assistance. A local high school could develop and circulate newsletters and brochures about the health of the watershed. All of these are examples of real volunteer assistance that has been provided to Virginia localities. Enlisting partners to assist in monitoring and implementation activities will also serve to build political support for the project.

In addition to enlisting volunteer assistance, budget and staff shortfalls can also be addressed by developing tiered levels of funding to carry out plan objectives. For example, a stream buffer revegetation plan could include three levels of implementation, with level of implementation determined by available funds. Level I could include voluntary community planting efforts in buffer areas, pursuing tree donations from local nurseries, or obtaining leftover seedlings from federal nurseries. Level II could include the provision of free trees and technical planting assistance to landowners. Level III could include county parks staff supplying the trees and organizing and conducting the entire planting and monitoring plan. Wherever possible, partnerships should be created to address plan objectives and actions. Partnerships not only save financial and staff resources, but also expand community responsibilities and ownership of the watershed to multiple stakeholder groups.

Finally, a locality could also integrate the workload for implementing the watershed plan as part of the appropriate local departments' regular scope of work and budget. This may also include exploring pursuing funding for complementary projects in the locality's capital improvements program. Another option is to pursue outside grant sources. Over-reliance on grant funds for watershed planning efforts can be problematic, as funding may vary from year to year. Outside grant funds may more appropriately serve as a resource for one-time costs associated with the watershed plan, like an initial watershed assessment, a stream bioengineering demonstration project or a watershed forum event. Whereas identifying projects in the capital improvements program of the comprehensive plan may provide a connection to a more stable source of local funding.

Section Nine: Progress Benchmarks

Benchmarks should be established to evaluate and quantify progress at regular intervals. Periodically the plan should be updated to reflect the changes identified through benchmarking.

Review and Evaluation

Once a watershed plan has been developed and implemented, localities will need to ensure that the plan is adequately reviewed and evaluated over time in order to assess ongoing challenges, opportunities, and successes. There are two levels of review and evaluation. First, the plan's individual goals and objectives need to be studied and evaluated. Second, the plan's overall implementation needs to be reviewed and assessed over time.

To review and evaluate a plan's individual goals and objectives, the plan should include specific guidelines. For example, if a plan goal is to protect fish habitat, an evaluation of existing fish habitat and fish species should be conducted prior to the development of specific habitat restoration objectives. Objectives and action plans should contain measurable targets for habitat protection or improvement, along with benchmarks to evaluate progress and contingency plans in case the objectives are not met.

There are several specific components that should be developed and included in a watershed plan to monitor the status of a plan's goals and objectives:

- *Specific methods should be detailed to measure the effectiveness of plan objectives. For example, objectives related to water quality improvements should have detailed monitoring plans designed to assess water quality.*
- *A clear methodology, timeframe, and responsible parties should be identified for monitoring of the objectives.*
- *To ensure consistency, the parameters and protocols used to collect baseline watershed information should also be used to measure water quality post-project.*
- *Milestones/benchmarks for achieving project objectives should be established.*
- *A formal reassessment process should provide for the ongoing evaluation and updating of goals and objectives that have not been met.*

An effective watershed plan does not need to contain a detailed monitoring plan, but the plan should include the components described above in order to ensure that watershed-related challenges, opportunities, and successes are adequately monitored and addressed over time. For example, if specific management practices, like forested buffers, are installed as part of a watershed protection strategy, then the performance of the buffers should be monitored to ensure they are working as intended. If trees were planted to restore a forested riparian buffer, the survival rate should be measured at least annually, and preferably at least biannually. If in-stream habitat restoration work is implemented to achieve a water quality improvement objective, the performance of the restoration work must be evaluated. If the restoration project is protecting one side of the stream while causing the other bank to erode, new engineering and installations may be needed.

Intermediate Indicators and Milestones

Intermediate indicators and milestones are an important part of an effective monitoring and evaluation strategy. These indicators and milestones are essentially in-process evaluation points that highlight interim achievements (an increase in fish populations) and indicate that a goal or objective has reached a certain stage (30% completion). For example, a sample objective for improving watershed habitat might select the presence of brook trout as an intermediate indicator of success and the number of additional trout spawning in the creek by spring 2004 as an intermediate milestone. The plan should include predetermined remedial actions in case intermediate indicators and milestones are not achieved. A sample objective with interim indicators and milestones are described below.

Provide a mechanism for ongoing watershed assessment

An effective watershed plan is not a report that can be developed and then left unchanged over time. Watersheds are dynamic environmental systems that are constantly changing. A community's land uses are also in constant flux, resulting in shifting land use patterns that impact the natural environment. As a result, the watershed plan should not only reflect community goals and objectives, but also include measures that evaluate the community's progress toward meeting those goals and objectives. For example, the watershed plan could include periodic physical, chemical, and biological stream monitoring requirements and a process to

Happy Trout Creek Watershed Plan

Goal 1: Restore water quality in Happy Trout Creek.
Objective 1: Reestablish riparian buffers.
Strategy 1: "Restore riparian buffers to 20 linear miles of Happy Trout Creek by fall 2004."

Interim Benchmark:

1) Fifty percent of trees and shrubs planted in buffer should survive at least two years after installation.

Intermediate Indicators and Milestones: Using planting plan, establish sample plots and monitoring schedule to evaluate buffer condition. Conduct monitoring and record those areas where buffer is not meeting fifty percent survival rate. Assess reasons for failure (e.g., mowing of young trees by maintenance department) and address problem/replant.

determine if water quality objectives are being achieved. Because of the complexity of natural systems and changes in land use patterns over time, watershed planning should be understood as an iterative process that needs to be revisited and updated on a regular basis.

Build a case for action based on impacts

An effective watershed plan should include a mechanism that allows for alterations and changes in the event that plan goals and objectives are not being met. For example, if periodic assessments indicate that water quality improvement goals have not been achieved, the situation should be documented and corrective actions taken. To plan for these situations, the watershed plan can include a series of detailed scenarios that establish potential future courses of action. For example, a plan could designate resources for educating developers about the voluntary use of low-impact development techniques to reduce storm water runoff and pollution. However, if monitoring indicates that pollution levels remain high and storm flows have not abated, the plan could stipulate the implementation of additional tools, like an updated storm water ordinance or extensive storm water retrofits, to address the concerns.

Conclusions

The development and implementation of watershed plans makes sense for several reasons. The protection and restoration of local watersheds benefits Virginia's natural environment. The protection and restoration of local watersheds provides a variety of benefits for Virginia's communities as well, including access to clean, healthy water supplies, abundant recreation opportunities, and the protection of public safety. Watershed plans assist localities in meeting new state and federal water quality requirements and provide a framework for meaningful citizen involvement in local water quality issues.

Effective local watershed management planning provides a new set of tools for communities to address policy challenges and new planning opportunities that extend beyond simply meeting minimum regulatory requirements. Effective watershed management can help communities ensure that surface and ground water supplies do not become degraded over time, that drinking water supplies are sustained, that soil and stream bank erosion is reduced, and that wildlife habitat is restored.

Each locality can play critical role

Whether a locality is large or small, rural or urban, each locality can play a critical role in shaping the health of their watersheds and communities. In already developed urban watersheds, there are many new tools, like rain gardens or brownfield redevelopment opportunities, to mitigate watershed challenges. Similarly, there a wide range of opportunities in rural watersheds to identify critical areas and channel growth so that natural resources and surface and ground water supplies are adequately protected.

Today, many of Virginia's communities have concluded that natural resource protection is important, not only in order to conserve natural resources for future generations, but also because sustainable local economies are invariably tied to well-conceived and implemented natural resource protection plans. One decision at a time, local watershed planning can make a real difference in the successful management of Virginia's natural resources.

Appendices

Appendix A: Virginia Planning Initiatives

The Relationship of Local Watershed Management Planning to Other Planning Initiatives

Virginia Planning Initiatives	Relationship
TMDL Implementation Plan (TMDLIP)	
The second step in the TMDL process, the TMDLIP, identifies the measures, costs and timeframes needed to implement the previously developed TMDL.	Watershed management planning (WMP) is broader than a TMDLIP because it addresses water quality, and riparian and habitat issues. Since TMDLIPs include specific actions and timetables, they are a starting point for a broader WMP. Incorporating the TMDLIP in the WMP puts the TMDL effort into the context of overall watershed protection efforts.
Tributary Strategies Plan	
Tributary strategies planning identifies the general range and amount of management measures needed in a Chesapeake Bay tributary to reduce nutrients and sediments in accordance with the developed load allocation	WMP can be the local planning unit upon which the basin-wide tributary plan is built and can be the local implementation plan for the larger Trib Strategy basin plan. When a TMDLIP for benthic impairments is included in a WMP, the included load reductions for nutrients and sediment could be integrated into local Trib Strategy implementation.
Storm Water Phase 2 Municipal Separate Storm Sewer Systems (MS4s)	
MS4 permits require separate municipal storm sewer system owners (usually local government or VDOT) to address six minimum control measures. Storm sewer planning can be a part of a local program.	WMP can provide the mechanism to meet as few as three and as many as six of the required minimum control measures, including public education and stakeholder outreach, public participation and implementation of good housekeeping, and pollution prevention measures. The purpose of WMPs is consistent with pollution prevention goals for the MS4 program.
Local Comprehensive Plan	
Local comprehensive plans guide the coordinated development of land within an jurisdiction. In Tidewater, comprehensive plans must address water quality protection and include several WMP components.	WMPs can be the vehicles for environmental inventory and evaluation of a jurisdiction's natural resources related to land use. WMPs can be the vehicle for watershed-specific guidance in comprehensive plan. Including WMPs and any TMDLIPs in the comprehensive plan will link future growth and development to specific implementation actions contained in the WMP and/or TMDLIP.
303(e) Water Quality Management Plans (WQMP)	
WQMPs focus on identified impairments or potential problems and consist of: 1) the Water Quality Management Plan Regulation - the waste load allocation component of TMDLs, in non-TMDL waters, effluent limitations, and stream segment classifications and 2) non-regulatory requirements such as TMDLIPs, other NPS management and pollutant reduction activities, and municipal and industrial waste treatment needs.	WMP can be the local planning unit upon which the non-regulatory plans addressing nonpoint source pollution are based and can be the local implementation plan for the same non-regulatory plans. When a TMDLIP for benthic impairments is included in a WMP, the included load reductions for nutrients and sediment can be integrated into implementation of the regulatory plan.

Appendix A: Virginia Planning Initiatives

Planning Element	Watershed Management Plan (WMP)	TMDL Implementation Plan	Tributary Strategies Plan	Storm Water Phase 2 (MS4)	Local Comprehensive Plan
Lead Responsibility	local government or community watershed organization	state or federal agency, local government, college/university, community organization	state government in cooperation with Chesapeake Bay Progam	MS4 owner - generally local government or VDOT	local government
Purpose	local protection, conservation and restoration of stream corridors, riparian forest buffers, and wetlands to improve habitat and water quality	implement NPS load allocations to restore the beneficial use of the resource	achieve and maintain the nutrient and sediment loading goals assigned to each tributary in order to restore bay living resources	reduce the discharge of pollutants to protect water quality and satisfy portions of the CWA and State Water Control Law	guide and accomplish coordinated, adjusted and harmonious development of land within jurisdiction Tidewater – incorporate the protection of the quality of state waters
Scale	one to several hydrologic units	small watershed up to several hydrologic units	entire watershed of each bay tributary, including multiple jurisdictions and hydrologic units	one to several hydrologic units within jurisdiction of MS4 owner	local government jurisdiction – one to several hydrologic units
Detail	specific to identified water quality and land use issues	specific to water quality impairment	specific to nutrient and sediment reductions for entire watershed	specific to storm water discharges issues	specific to the physical development of the jurisdiction. Controls the general or approximate location, character and extent of each physical feature (roadways, utilities, etc.) Tidewater – specific to a) physical constraints to development, b) protection of water supply, c) shoreline erosion control, d) public-private waterfront access, and e) water quality improvement potential from redevelopment
Stakeholder Involvement	Yes, watershed-wide	Yes, watershed-wide	Yes, at basin level	Yes, storm sewer system-wide	Yes, jurisdiction-wide
Watershed Goals	Yes, watershed-wide and addressing all water quality issues	Yes, specific to water quality impairment	Yes, specific to nutrient reductions	Not required	Not required Tidewater - required for purpose of protecting the quality of state waters

Appendix A: Virginia Planning Initiatives

Planning Element	Watershed Management Plan (WMP)	TMDL Implementation Plan	Tributary Strategies Plan	Storm Water Phase 2 (MS4)	Local Comprehensive Plan
Environmental Inventory and Evaluation	Yes, watershed-wide and addressing all land use & water quality issues	Yes, specific to water quality impairment	Yes, specific to CBP model parameters and nutrient and sediment reductions	Yes, specific to stormwater discharges issues	Permissive components for: conservation; floodplains; drainage; the designation of areas for implementation of reasonable ground water protection measures Tidewater - specific checklist items to protect quality of state waters
Analysis of Stakeholder Roles and Responsibilities	detailed by stakeholder	detailed by stakeholder	broadly assesses responsibilities	describes MS4 owner's responsibilities	describes local government's responsibilities Tidewater - broadly assesses other agency responsibilities
Implementation Strategies and Actions	yes, specific actions, timeframes and costs	yes, specific to sources, targeted and phased restoration activities	yes, broad, basin-wide	yes, specific stormwater actions, timeframes and costs	specific locations, character and extent of each physical feature such as roadways Tidewater - strategies and actions to protect water quality
Identification of Needed Resources	yes, actual costs	yes, actual costs for both implementation and technical assistance	yes, broad, basin-wide	yes	no but may include costs in capitol improvement program Tidewater - yes - part of the action plan
Commitment to Implement	yes, by planning participants	yes, when federal money is available	yes	yes	yes
Monitoring and/or Tracking	yes	Yes	yes	yes	yes Tidewater oversight by CBLAD
Deadlines	2010	2010	2004	2008	ongoing – updated and revised every five years
Information for this table was provided by:	DCR Chesapeake Bay Office and C2K Commitment 2.2.1	DCR TMDL Program, WQMIRA	CBP website, memo to Russ Baxter	9 VAC 25-759-10 et seq	*Code of VA* 15.2-2223-2228 and 15.2-2232

Appendix B: Programs Providing Planning and Implementation Assistance in Virginia

Appendix B – Programs Providing Planning and Implementation Assistance in Virginia

Data and Planning Resources

The programs described below provide technical and/or financial help for watershed management planning**.**

Abandoned Mine Land Program

The Abandoned Mine Land (AML) Program of the Virginia Department of Mines, Minerals and Energy, Division of Mined Land Reclamation (DMLR), was established in the late 1970s to abate pre-federal act coal mine related problems adversely affecting public health, safety, general welfare and the environment. Problems related to abandoned mine land include landslides, stream sedimentation, hazardous structures, dangerous highwalls, subsidence, loss of water, acid mine drainage and open mine portals. Virginia maintains an AML inventory of abandoned mine problems throughout the state. These high priority projects pose the greatest threat to public health and safety and the environment.

Virginia's AML Program is widely recognized as among the nation's best. It provides technical assistance and, when available, funding for projects that eliminate highwalls, cover and re-vegetate eroding outslopes and abate acid mine drainage problems.

Contact: (276) 523-8206 or visit http://www.dmme.state.va.us/dmlr.html

Chesapeake Bay Preservation Act

The Chesapeake Bay Preservation Act and Regulations established a cooperative program between state and local governments aimed at improving water quality in the Chesapeake Bay and its tributaries by promoting the application of sound land use planning and management practices on environmentally sensitive lands. The act requires local governments to incorporate general water quality protection measures into their comprehensive plans, zoning ordinances and subdivision ordinances. Although Tidewater localities are required to adopt and implement the act, local governments outside of Tidewater may also adopt bay act programs. Adopting and implementing a local program requires localities to map environmentally sensitive lands, develop or amend ordinances to implement performance criteria, amend comprehensive plans to address water quality, and evaluate their local ordinances and policies to identify and address any conflicts and barriers to protecting water quality.

CBLAD provides technical and financial assistance to local governments in developing and implementing their programs. The agency also provides advice on better site design and low impact development.

Contact: CBLAD, 1-800-CHES-BAY, http://www.cblad.state.va.us

Chesapeake Bay Program

The Chesapeake Bay Program, created in 1983 by the first Chesapeake Bay Agreement, is a unique regional partnership leading and directing restoration of the Chesapeake Bay. Partners include Maryland, Pennsylvania, Virginia, the District of Columbia, the Chesapeake Bay Commission (a tri-state legislative body), the EPA, and citizen advisory groups. In June 2000, partners signed *Chesapeake 2000*, a comprehensive and far-reaching agreement guiding efforts to

restore and protect the bay through 2010. *Chesapeake 2000* outlines 93 commitments critical to restoring the bay watershed's health. More than in previous agreements, *Chesapeake 2000* commitments recognize the importance of locally driven initiatives to restore and protect the bay. About one-third of the commitments address actions at the local government level.
The Chesapeake Bay Program has developed a wide range of data and tools to help state and local governments and community organizations restore the bay.
Contact: Chesapeake Bay Program
410 Severn Avenue, Suite 109
Annapolis, MD 21403
Call (410) 267-5700 or (800) YOUR-BAY, http://www.chesapeakebay.net

Forest Management and Preservation Programs

The Virginia Department of Forestry has numerous programs to promote sound forest management and preservation including urban and community forestry initiatives, water quality reference stream initiatives, a riparian buffer initiative and an extensive geographical information system with links to other useful planning databases.
The riparian buffer initiative aims to ensure that adequate buffer protects all streams and shorelines in the state through agency partnerships with organizations, businesses and private landowners to establish, enhance and maintain riparian buffers. The program also seeks to conserve existing forest buffers and enhance program coordination and accountability. The Riparian Buffer Implementation Plan was published in July 1998.
Contact: http://www.dof.state.va.us/resinfo/index.shtml (resource data)
http://www.dof.state.va.us/rfb/index.shtml (riparian forest buffers)

Rivers and Trails Conservation Assistance Program

The Rivers, Trails and Conservation Assistance Program, a.k.a. the Rivers and Trails Program, or RTCA, is a community resource of the National Park Service. Program staff works with community groups, localities and state governments to conserve rivers, preserve open space, and develop trails and greenways. The RTCA program developed a community toolbox, suitable for community organizations and professional planners, to facilitate community-based watershed projects, including planning.
Visit: http://www.nps.gov/phso/rtca/
http://www.nps.gov/sero/rtca/se_rivers.htm

Virginia Nonpoint Source Pollution Management Program

DCR coordinates and directs programs and services to prevent degradation of the state's water quality and quantity. Statewide nonpoint source pollution control programs and services support individual stewardship, and lend assistance to local governments with watershed-based resource management. Technical and financial assistance, education and research are enhanced by funds from the federal NPS Pollution Control Program and the Chesapeake Bay Program. A statewide system of 494 watersheds analyzed for NPS pollution potential drives how these activities are targeted. Services are delivered to local governments, special interest groups and citizens by staff in eight regional watershed offices.
Contact: 1-877-42WATER, visit http://www.dcr.state.va.us

Appendix B: Programs Providing Planning and Implementation Assistance in Virginia

Virginia Water Monitoring Council (VWMC)

The VWMC inventories Virginia's various water monitoring programs, including data collected by agencies, local governments, colleges, citizen groups, etc. The inventory is posted on the VWMC's website: http://www.vwrrc.vt.edu/vwmc. Users search the inventory by major watershed, monitoring parameter, county/city and organization type. Links to websites of water monitoring programs are also posted.

Because VWMC members represent state and federal agencies, local governments, environmental consulting firms, faculty at universities, citizens and others, the organization has an extensive collective knowledge of technical and practical information about watersheds and watershed planning, as well as water monitoring). The VWMC shares information through workshops, its website, e-mail, and to individuals.

The following DCR programs support local watershed management planning:

Conservation Lands Database

The database includes mapped boundaries and certain characteristics of public and certain private lands in Virginia that have conservation, recreation and open-space. Included are many federal and state lands, parks and undeveloped or partially developed lands owned by localities. Also, lands owned as preserves by nonprofit conservation organizations such as The Nature Conservancy, and conservation easements held by the Virginia Outdoors Foundation, land trusts and others, are covered. This geographic information system (GIS) is in ArcView shape file format and can be viewed, queried and manipulated using appropriate GIS software
Contact: http://www.dcr.state.va.us/olc/index.htm

VA Floodplain Management Program

DCR coordinates the National Flood Insurance Program at the state level. The agency's floodplain management staff works with localities to establish and enforce floodplain management zoning. Localities use the program's model ordinances, which set minimum federal standards, to write and enact their own floodplain management ordinances. Local governments can set more restrictive standards for greater protection in flood hazard areas. Floodplain zoning regulates development within floodplains. A city, town or county must participate in the National Flood Insurance Program for its business and residential properties to be eligible for national flood insurance purchase.
Visit: http://www.dcr.state.va.us/sw/floodpln.htm

Stream Restoration and Corridor Protection

DCR has technical staff available to help community groups, local governments, state and federal land management agencies, environmental regulatory agencies, and watershed management planners develop stream corridor protection, conservation and restoration components of watershed management plans. Such assistance includes associated construction inspection. Contact the local DCR Watershed Office or call 1-877 42WATER for details.

Virginia Karst Program

Appendix B: Programs Providing Planning and Implementation Assistance in Virginia

This program addresses nonpoint source pollution in Virginia's 27 counties that contain karst landscapes. It provides on-call technical assistance to localities, businesses, individuals and other groups. The staff specializes in watershed delineation, sinkhole and sinking stream protection, erosion and sediment control, and stormwater and nutrient management. The state karst education coordinator conducts workshops for various audiences provides Project Underground curriculum used to train teachers and other environmental educators, who then pass the knowledge on to their students. Call (540) 831-4056.

Virginia Outdoors Plan

The Virginia Outdoors Plan (VOP) is the state's official conservation, outdoor recreation and open space plan. It guides all levels of government and the private sector. Implementing its recommendations can ensure that Virginia's rich outdoor heritage is passed on to future generations. The plan also meets criteria for participation in various land conservation grant programs.
Visit: http://www.dcr.state.va.us/prr/vopfiles.htm

The following DEQ programs support local watershed management planning:

Virginia Water Programs

DEQ administers the federal Clean Water Act and enforces state laws to improve the quality of Virginia's streams, rivers, bays and ground water for aquatic life, human health and other water uses. Permits are issued to businesses, industries, local governments and individuals that take into account physical, chemical and biological standards for water quality. Water quality monitoring, assessment and planning are used to determine how clean Virginia's waters are and if it is as clean as it should be.
Contact: 1-800-592-5482
http://www.deq.state.va.us

Virginia Coastal Program

The Virginia Coastal Program, established in 1986 as a network of state agencies and local governments, is dedicated to preserving, protecting and restoring the natural beauty and ecological function of Virginia's coastal zone while fostering appropriate economic growth and development. This balance is achieved through the cooperation of supporting projects and programs throughout Tidewater Virginia that address coastal issues. One example is development and implementation of Special Area Management Plans (SAMPs) – long-term, locally supported planning and implementation projects. SAMPs are rooted in the principle of coordinating multi-level planning to protect significant natural resources through the development and implementation of enforceable policies.
Visit: http://www.deq.state.va.us/coastal/

Virginia Total Maximum Daily Load Program

Total maximum daily load (TMDL) describes the amount of pollution a stream can receive and still meet Virginia's water quality standards. TMDLs are required for water bodies considered "impaired" by Virginia's water quality assessment procedures. The Virginia TMDL program is

governed by a federal court order Consent Decree that lays out a schedule for TMDL development through 2010. Local watershed management planning that involves an impaired segment of waterway or a completed TMDL should be coordinated with the TMDL process.
Visit: http://www.deq.state.va.us/tmdl.html

Virginia Citizen Water Quality Monitoring Program

The Virginia Citizen Water Quality Monitoring Program is a public-private partnership among the Alliance for the Chesapeake Bay, DCR, DEQ, and Virginia Save Our Streams. The program provides assistance to organizations and local governments identifying available monitoring data. It can be an avenue to connect active stakeholders to watershed planning. It provides technical and, when available, financial assistance to community groups for the collection and use of meaningful water quality monitoring data.
Contact: http://www,deq.state.va.us/cmonitor

Water Quality Assessment Activities

The DEQ extensively tests Virginia's rivers, lakes and tidal waters for pollutants. Waters are tested for more than 130 pollutants to determine if the waterways can be used for swimming, fishing and drinking. Most rivers, lakes and estuaries in Virginia meet standards as described in biennial Water Quality Assessment Reports. Waters that do not meet standards are reported to the citizens of Virginia and the EPA in the Impaired Waters Report. This information is available online for local planning initiatives.
Visit: http://www.deq.state.va.us/water/reports.html
http://www.deq.state.va.us/water/wqmap.html

Water Quality Management Plans

Water Quality Management Plans are being written under the 'Continued Planning Process' established by Section 303(e) of the Clean Water Act. These plans will serve as a repository for TMDL plans and for TMDL implementation as approved by the State Water Control Board.
Visit: http://www.deq.state.va.us/watersheds/programs.html

Other Useful Websites

Virginia Cooperative Extension
http://www.ext.vt.edu

Virginia Department of Game and Inland Fisheries
http://www.dgif.state.va.us

Virginia Economic Development Partnership
http://www.yesvirginia.org/vascan.asp

Virginia Marine Resources Commission
http://www.mrc.state.va.us

Appendix B: Programs Providing Planning and Implementation Assistance in Virginia

Technical, Regulatory, and Financial Assistance Programs

Programs and Initiatives Addressing Agricultural Land Uses

Virginia Agricultural Best Management Practices (BMPs) Cost-Share Program

This program encourages farmers to voluntary install practices that protect water quality and conserve soil. The program provides incentives for the installation of BMPs on a flat per-acre rate, up to 75 percent of the estimated cost, or a combination of flat rate and 75 percent of estimated component costs. The maximum amount an applicant can receive in a program year is $50,000.

Contact: visit http://www.dcr.state.va.us/sw/costshar.htm or contact your local soil and water conservation district, or call (804) 371-7330

Virginia Agricultural Best Management Practices Loan Program

The program, administered by DEQ, is a source of low interest financing to encourage the use of specific BMPs that reduce or eliminate agricultural nonpoint source pollution in Virginia's waters. The minimum allowable loan is $5,000, and repayment periods range from one to ten years.

Visit: http://www.deq.state.va.us/cap/aghome.html

Virginia Agricultural Best Management Practices (BMPs) Tax Credit Program

This program encourages voluntary installation of BMPs that will address Virginia's nonpoint source pollution water quality objectives by allowing individuals engaged in agricultural production for market to take a tax credit for agricultural BMPs installed to improve water quality. The tax credit is 25% of the first $70,000 expended for the agricultural BMPs by the individual or corporation against the imposed state income tax. The amount of the tax credit shall not exceed $17,500 or the total amount of state income tax obligation for the individual. If the amount of the credit exceeds the taxpayer's liability for such a taxable year, the excess may be carried over for credit against income taxes in the next five years or until they have taken the total of the tax credit.

Contact: visit http://www.dcr.state.va.us/sw/costshar.htm or contact your local soil and water conservation district, or call (804) 371-7330

Conservation Reserve Enhancement Program (CREP)

CREP is a unique partnership of state, local and federal agencies, and private conservation groups. It aims to improve water quality and wildlife habitat by offering financial incentives to farming landowners who voluntarily restore riparian buffers, native warm season grass filter strips and wetlands. Partners include the state departments of Conservation and Recreation, Forestry (DOF), Game and Inland Fisheries (DGIF), and Chesapeake Bay Local Assistance Department (CBLAD); soil and water conservation districts (SWCDs); Virginia Cooperative Extension; USDA Natural Resources Conservation Service (NRCS) and Farm Service Agency (FSA); U.S. Fish and Wildlife Service; Chesapeake Bay Foundation; and Ducks Unlimited.

Funding is available for fencing to keep livestock out of streams and rivers to reduce fecal coliform and sediment; well-drilling and alternative watering systems to support agricultural production; wetland restoration; and riparian buffer planting to filter nitrogen, phosphorus and sediment.

Conservation practices installed under CREP receive 50 percent cost-share reimbursement from FSA and up to 25 percent from DCR through SWCDs. Also, the Chesapeake Bay Foundation and Ducks Unlimited contribute to wetland restoration efforts and enhanced buffer plantings. The program offers yearly rental payments for 10- or 15-year federal contracts. Through DCR, a $500/acre incentive is available for CREP enrolled acres placed under a permanent open space easement.
Visit: http://www.dcr.state.va.us/sw/crep.htm and
http://www.dcr.state.va.us/sw/docs/FSAlocs.pdf

Conservation Reserve Program (CRP)

Similar to CREP, the CRP provides annual rent payments to landowners with highly erodible land to allow them to remove that land from production and plant it with conservation species for at least 10 years. It provides cost-share funds for planting trees and other vegetative cover. To be eligible, the cropland must have been planted with commodity crops two of the five most recent crop years.
Visit: http://www.nrcs.usda.gov/programs/

Wildlife Habitat Incentives Program (WHIP)

WHIP is a voluntary program through which cost-share and technical assistance are provided to private landowners to develop and improve fish and wildlife habitat. Participants who own or control land write and implement a wildlife habitat development plan. The program is managed by the Natural Resources Conservation Service (NRCS). Duration of the assistance is from five to ten years.
Contact: Cooperative Extension Service, local conservation district or visit
http://www.ftw.nrcs.usda.gov/pl566/WHIP.html

Environmental Quality Incentives Program (EQIP)

EQIP provides technical, educational and financial help to eligible farmers and ranchers to address soil, water and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. This is done through implementation of a conservation plan that includes structural, vegetative and land management practices. Contracts run from five to ten years, and cost-share provisions are possible.
Contact: USDA Natural Resources Conservation Service; visit
http://www.nrcs.usda.gov/programs/

Wetland Reserve Program (WRP)

WRP is a voluntary program to restore and protect wetlands on private property. It offers three options:

Permanent easements: Landowners receive the agricultural value of the land, up to a maximum cap, plus 100 percent of the cost of restoring the land.
30-year easements: Landowners receive 75 percent of the easement value and 75 percent cost-share on the restoration.
Restoration cost-share agreements with a minimum 10-year duration: Landowners receive 75 percent of the restoration cost.

Visit: http://www.nrcs.usda.gov/programs/wrp

Emergency Watershed Protection Program

This program, administered by NRCS, provides direct technical aid to restore streams in response to natural disasters. Debris removal, stream bank reshaping, and the reseeding of damaged areas are examples of practices the program covers. A local sponsor must submit a request for assistance.

Visit: http://www.attra.ncat.org/guide/ewp.htm

Agricultural Stewardship Program

The Agricultural Stewardship Act *(ASA)* enables farmers to voluntarily correct water quality problems before enforcement action is taken. Water quality problems concerning nutrients, sediment and toxics from agricultural activities are reported to the Virginia Department of Agriculture and Consumer Services (VDACS). The program aims to educate farmers about environmental stewardship and identify real water-quality problems. Through the program, farmers are directed to soil and water conservation districts for help in correcting problems in a common sense manner, accommodating both the farmer and the environment.

Contact: VDACS Office of Policy, Planning and Research - (804) 786-3538.

Programs and Initiatives Addressing Non-Agricultural Land Uses

Erosion and Sediment Control Law and Regulations

DCR implements the state Erosion and Sediment Control (ESC) Program according to the Virginia Erosion and Sediment Control Law, Regulations and Certification Regulations. The program's goal is to control soil erosion, sedimentation and nonagricultural runoff from *regulated land-disturbing activities* to prevent degradation of property and natural resources. The regulations specify minimum standards, which include criteria, techniques and policies, that must be followed on regulated activities.

Most private projects involving land disturbance are regulated through local government-operated ESC programs whereas DCR's ESC staff oversees state and federal activities. While property owners are ultimately responsible for ESC plan approval and implementation, responsibility for ensuring compliance extends to the developer, contractor, consultant and Virginia's citizenry. The success of ESC programs affects various interests, from those who own, rent or develop property to those who reside or recreate on lands or waters adjacent to or downstream from land-disturbing activities.

Contact: Visit http://www.dcr.state.va.us/sw/e&s.htm or call local government

Appendix B: Programs Providing Planning and Implementation Assistance in Virginia

Stormwater Management

DEQ, DCR and CBLAD coordinate separate state programs through which the pollution carried by stormwater runoff is regulated. The programs arose from state and federal laws addressing surface water contamination from land use activities.

The federal Clean Water Act, Municipal Separate Storm Sewer System (MS4) Program, requires cities and urbanized counties having a population greater than 100,000 to develop stormwater management plans and obtain discharge permits for stormwater outfalls. In Virginia this program is administered by DEQ, which issues Virginia Pollutant Discharge Elimination System permits to localities. Companies must submit applications to DEQ to ensure that stormwater discharges directly entering streams from industrial facilities also are regulated.

The Virginia Stormwater Management Act, administered by DCR, enables local governments to establish management plans and adopt ordinances that require control and treatment of stormwater runoff to prevent flooding and contamination of local waterways. Local programs must meet or exceed minimum standards contained in regulations. Under the act, state agencies must use management practices on their facilities even if the locality in which they lie has no such program.

The Chesapeake Bay Preservation Act requires stormwater management within Chesapeake Bay preservation areas in all Tidewater localities. Localities enforce their own programs, which are based on a model developed by CBLAD.

Visit: http://www.deq.state.va.us/water/bmps.html
http://www.dcr.state.va.us/sw/stormwat.htm or
http://www.cblad.state.va.us/guid.cfm or
call local government

Programs and Initiatives Addressing General Watershed-Based Implementation

Catalog of Federal Funding Sources for Watershed Protection

The Catalog of Federal Funding Sources for Watershed Protection website is a searchable database of financial assistance sources (grants, loans, cost-sharing) available to fund a variety of watershed protection projects. Users can use either of two searches to select funding programs for particular requirements. One is based on subject matter, the other on keywords. Criteria searches include the type of organization (e.g., nonprofit groups, private landowner, state, business), type of assistance sought (grants or loans) and keywords (e.g., agriculture, wildlife habitat). Searches yield a list of programs by name and detailed information on the funding source.
Visit: http://www.epa.gov/watershedfunding

Virginia Coastal Program

The Virginia Coastal Program was established in 1986 as a network of state agencies and local governments dedicated to preserving, protecting and restoring the natural beauty and ecological

function of our coastal zone while fostering appropriate economic growth and development. The Coastal Program achieves this balance and spirit of cooperation by supporting projects and programs throughout Tidewater Virginia that address coastal issues. Funding is periodically available for implementation of projects and polices that support the program's 10 goals.
Visit: http://www.deq.state.va.us/coastal/

Watershed Roundtables

A watershed roundtable consists of people who have a vested interest in their communities and are concerned about local water quality. In Virginia, watershed roundtables are known by a variety of names, such as the Big Sandy River Basin Coalition, the Rappahannock River Basin Commission and the Pure Water 2000 Forum. A roundtable can be the driving force in the watershed, providing education, outreach and solutions to restore and protect water quality. Roundtables generally involve a diversity of participants. Their activities address many common community water quality concerns by hosting forums to present watershed issues on local water quality and land use, educating citizens about water quality, seeking grants, donations and other funding sources, coordinating workshops, collecting and analyzing water quality data, participating in the TMDL planning, and planning and implementing watershed-wide water quality goals. Each major watershed in Virginia has a roundtable.
Contact: 1-877-42WATER or call local DCR Watershed Office or visit http://www.dcr.state.va.us/sw/wsheds.htm

Chesapeake Bay Restoration Fund (License Plate Program)

In 1992, the Virginia General Assembly established the Chesapeake Bay preservation license plate. The colorful plate reads, “Friend of the Chesapeake.” The assembly’s Virginia Division of Legislative Services administers revenue from license plate sales. Grants are available to state agencies, local governments, schools and nonprofit groups for environmental education and restoration projects.
Contact: Division of Legislative Services at (804) 786-3591

Water Quality Improvement Fund

The Water Quality Improvement Act of 1997 established cooperative programs for nutrient reduction and other point and nonpoint sources of pollution. The Water Quality Improvement Fund (WQIF) was created to provide water quality improvement grants to local governments, soil and water conservation districts and individuals. A primary objective is to fund projects that reduce the flow of excess nitrogen and phosphorus into state waters. DEQ manages point source grants, and DCR handles nonpoint source grants.
Contact: Visit http://www.deq.state.va.us/bay/wqif.html or (804) 698-4466
Visit http://www.dcr.state.va.us/sw/wqia.htm or (804) 371-8984

Coastal Nonpoint Source Pollution Control Program

States like Virginia, with approved coastal zone management programs, are required to focus NPS pollution control efforts to restore and protect coastal water quality by applying economically achievable BMPs. These are implemented through enforceable state policies and mechanisms.

Appendix B: Programs Providing Planning and Implementation Assistance in Virginia

The federal government defines state-enforceable policies and mechanisms as state and local regulatory controls and/or non-regulatory incentive programs combined with a state enforcement authority. DCR is the lead state agency for the Coastal Nonpoint Source Pollution Control Program.
Contact: Visit http://www.dcr.state.va.us/sw/czreauth.htm or call (804) 692-0839

Scenic Rivers

The Virginia Scenic Rivers Act was passed in 1970 to protect and preserve certain rivers or sections thereof possessing natural or pastoral beauty. Nineteen rivers or river segments have been designated, including one State Historic River. Ten more, which have been evaluated and found to quality for designation, are identified in the *2002 Virginia Outdoors Plan*. Local support is necessary for the designation of scenic river status, and the state legislature and governor must approve each addition to Virginia's Scenic River system. The scenic rivers system comprises tidal and non-tidal rivers and extends from the coastal Virginia to the mountains. Inclusion in the scenic rivers system provides a framework whereby the river's preservation is encouraged. DCR works with localities and citizens to study potential scenic rivers and encourages their participation in evaluation. Following evaluation, the locality is notified whether or not the river qualifies. If the river qualifies, DCR informs citizens and government officials about the program and their roles in resource management.
Visit: http://www.dcr.state.va.us/lanm_sum.htm

Appendix C – Resource Bibliography

Here are additional resources for watershed planning and community involvement.

"Applied River Morphology." 1996. This technical publication outlines the fundamental principles of river function and the classification of natural rivers, depicting major stream types. It's useful for watershed management, ecosystem assessment, fish habitat evaluation, river restoration and nonpoint source pollution reduction. Source: Wildland Hydrology Books, 1481 Stevens Lake Rd., Pagosa Springs, CO 81147. Call (970) 264-7100. ($89.95 plus shipping and handling)

"Better Site Design: An Assessment of Better Site Design Principles for Communities Implementing Virginia's Chesapeake Bay Preservation Act." Source: Center for Watershed Protection, 8737 Colesville Rd., Suite L105, Silver Spring, MD 20910. Call (410) 461-8323 or e-mail mrrunoff@usapipeline.com. ($35)

"Check Your Success." A guide to developing indicators for community based environmental projects, useful for benchmarking and measuring progress. Source: Virginia Tech, Department of Urban Affairs & Planning and USEPA. Available online at http://www.uap.vt.edu/checkyoursuccess/manual.html .

"Clean Water in Your Watershed: A Citizens Guide to Watershed Protection." Provides a process for citizen-based watershed project planning. Source: Terrene Institute, 1717 K Street, NW, Suite 801, Washington, DC 20006 Call (202) 833-8317. http://www.terrene.org

"Collaboration: A Guide for Environmental Advocates." 2001. This guide is useful for determining if a collaborative approach is appropriate for resolving environmental issues. It includes processes and tips for designing and implementing collaborative approaches. Source: Institute for Environmental Negotiation, 164 Rugby Rd, P.O. Box 400179, University of Virginia, Charlottesville, VA 22904-4179. (Free PDF copies available online at: http://www.virginia.edu/ien/; bound copies $8)

"Community Watershed Forums: A Planner's Guide." 2002. This guide describes how to plan and host community forums to engage your community in watershed planning. Source: Institute for Environmental Negotiation, 164 Rugby Rd, P.O. Box 400179, University of Virginia, Charlottesville, VA 22904-4179. (Free PDF copies available online at: http://www.virginia.edu/ien/ paperback $25)

"A Framework for Analyzing the Hydrologic Condition of Watersheds." This document details technical procedures for analyzing existing conditions in a watershed. The procedures detail yield, timing and quality of water. Source: USDA-Forest Service and USDI-Bureau of Land Management, June 1998. Item numbers BLM Technical Note 405 and BLM/RS/ST-98/004+7210

"Getting In Step: A Guide to Effective Outreach in Your Watershed." Provides tools and approach to develop and implement an effective watershed outreach plan. Source: Council of State Governments, PO Box 11910, Lexington, KY 40578-1910 Call (859)244-800. (Free PDF copies available online at http://www.epa.gov/owow/watershed/outreach/documents)

Appendix C – Resource Bibliography

"Getting In Step: Engaging and Involving Stakeholders in Your Watershed." This guide provides tools needed to effectively engage stakeholders to restore and maintain healthy environmental conditions through community support and cooperative action. Source: Tetra Tech, Inc. (Free PDF copies available online at http://www.epa.gov/owow/watershed/outreach/documents)

"Guidance Manual for Total Maximum Daily Load Implementation Plans." A must-have for any local watershed management planning that includes a TMDL planning effort. Source: Virginia Department of Conservation and Recreation, TMDL Program Manager. Call: (804) 786-3199.

"Know Your Watershed Guides." This series provides guides for watershed partnerships. Source: http://www.ctic.purdue.edu/KYW/kyw.html

"The Practice of Watershed Protection: Techniques for Protecting and Restoring Urban Watersheds." A compilation of 150 articles on all aspects of urban watershed protection from the journal, *Watershed Protection Techniques*. Source: Center for Watershed Protection. Call (410) 461-8323; copies available online at http://www.cwp.org. ($80)

"Rapid Watershed Planning Handbook." This handbook includes a comprehensive approach for developing a cost-effective watershed plan. It covers management options, analysis tools and watershed plan case studies. Source: Center for Watershed Protection. Call (410) 461-8323 or copies are available online at http://www.cwp.org. ($40)

"Restoring Streams in Cities: A Guide for Planners, Policymakers and Citizens." 1998. The book covers urban stream restoration concepts for use by citizens, mayors, county commissioners, flood control engineers and others interested in improving local waterways. Source: Island Press, Box 7, Department 2NET, Covelo, CA 95428 Call (800) 828-1302. ($35 paperback)

"Stream Channel Reference Sites: An Illustrated Guide to Field Technique." This is a 61-page technical guide on establishing permanent reference sites for gathering data about physical characteristics of streams and rivers. Source: U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Publications, 3825 E. Mullberry, Fort Collins, CO 80524. Call (970) 498-1100 and ask for General Technical Report 145. (Free)

"A Stream Corridor Protection Strategy for Local Governments." 2002. This handbook contains the cumulative wisdom of watershed experts from across the Chesapeake Bay watershed and covers stream protection strategies and tools, such as stream buffers and zoning overlays, and resources for conducting a protection strategy. Source: Institute for Environmental Negotiation, 164 Rugby Rd, P.O. Box 400179, University of Virginia, Charlottesville, VA 22904-4179. (Free PDF copies available at: http://www.virginia.edu/ien/; bound copies $8)

"Water in Environmental Planning." 1978. Technical reference for watershed planning principles. Source: W.H. Freeman and Co., 4419 West 1980 South St., Salt Lake City, UT 84104. Call (800) 877-5351. ISBN No. 07167-0079-4. ($87.95, plus shipping and handling)

Appendix C – Resource Bibliography

"Living With Karst – A Fragile Foundation." This book vividly illustrates what karst is and why karst-rich areas are important. It covers karst-related environmental and engineering concerns, guidelines for living with karst and sources of additional information. Source: American Geological Institute, 4220 King Street, Alexandria, VA 22302. (703) 379-2480.http://www.agiweb.org Copies also available through the Virginia Karst Program.

"Living on Karst – A Reference Guide for Landowners in Limestone Regions." This guide helps residents of karst areas learn about how day-to-day activities affect their groundwater and fragile ecosystems. Source: Cave Conservancy of the Virginias, 13131 Overhill Lake Lane, Glen Allen, VA 23059. Available online at http://www.caveconservancy.org